

# **DEVICE TO PRODUCE POLYURETHANE ARTICLES, RELATIVE METHOD AND POLYURETHANE ARTICLES THUS OBTAINED**

**Patent number:** WO0220239  
**Publication date:** 2002-03-14  
**Inventor:** DAMO MARIO (IT)  
**Applicant:** G M P POLIURETANI SPA (IT); DAMO MARIO (IT)  
**Classification:**  
- international: B29C45/14; B29C44/14  
- european: B29C45/14E; B29C45/14B; B29C45/14D2  
**Application number:** WO2001IB01582 20010831  
**Priority number(s):** IT2000UD00163 20000905

## **Also published as:**

EP1230076 (A1)  
US6682819 (B2)  
US2002163100 (A1)  
CA2404676 (A1)  
EP1230076 (B1)

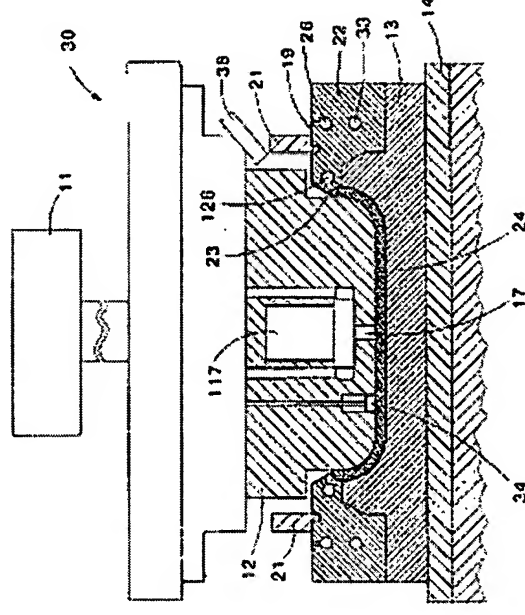
## **Cited documents:**

WO9603267  
WO9527604  
WO0012282  
DE4033297  
EP0584042  
more >>

**Report a data error here**

## **Abstract of WO0220239**

Device to produce polyurethane articles (37) covered by a film (19), including a mold (30) comprising a female part (13) and a male part (12) defining a molding cavity (18) inside which polyurethane material (24) is able to be injected. The device also comprises, in association with the perimeter edge of said female part (13), means able to exert a connection function in substantial cooperation with the zone of discontinuity between said female part (13) and said male part (12). The means comprise a movable annular ring-nut (22) including a first position (22a) to load a segment of said film (19) in order to insert said segment inside the mold, and a second position (22b) at least partly overlapping on the perimeter of said female part (13) in order to cooperate with said female part (13) during the molding of said polyurethane material (24).



(19) World Intellectual Property Organization  
International Bureau



(43) International Publication Date  
14 March 2002 (14.03.2002)

PCT

(10) International Publication Number  
**WO 02/20239 A1**

(51) International Patent Classification<sup>7</sup>: **B29C 45/14**,  
44/14

(21) International Application Number: **PCT/IB01/01582**

(22) International Filing Date: **31 August 2001 (31.08.2001)**

(25) Filing Language: **English**

(26) Publication Language: **English**

(30) Priority Data:  
**UD2000A000163**  
**5 September 2000 (05.09.2000) IT**

(71) Applicant (for all designated States except US): **G.M.P. POLIURETANI SPA [IT/IT]; Via Padova, 5/9, Z.I., I-31046 Oderzo (IT).**

(72) Inventor; and

(75) Inventor/Applicant (for US only): **DAMO, Mario [IT/IT]; Viale Frassinetti, 15, I-31046 Oderzo (IT).**

(74) Agent: **PETRAZ, Gilberto; GLP Srl, Piazzale Cavedalis, 6/2, I-33100 Udine (IT).**

(81) Designated States (*national*): AE, AG, AL, AM, AT, AU, AZ, BA, BB, BG, BR, BY, BZ, CA, CH, CN, CO, CR, CU, CZ, DE, DK, DM, DZ, EC, EE, ES, FI, GB, GD, GE, GH, GM, HR, HU, ID, IL, IN, IS, JP, KE, KG, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, MA, MD, MG, MK, MN, MW, MX, MZ, NO, NZ, PH, PL, PT, RO, RU, SD, SE, SG, SI, SK, SL, TJ, TM, TR, TT, TZ, UA, UG, US, UZ, VN, YU, ZA, ZW.

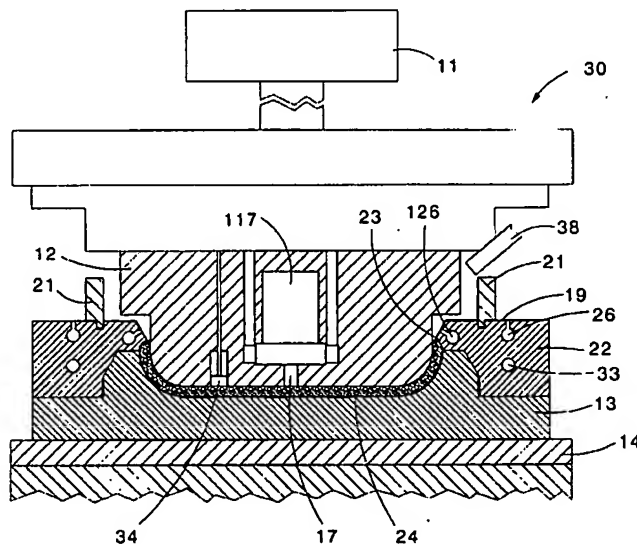
(84) Designated States (*regional*): ARIPO patent (GH, GM, KE, LS, MW, MZ, SD, SL, SZ, TZ, UG, ZW), Eurasian patent (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European patent (AT, BE, CH, CY, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE, TR), OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, ML, MR, NE, SN, TD, TG).

**Published:**

— with international search report

For two-letter codes and other abbreviations, refer to the "Guidance Notes on Codes and Abbreviations" appearing at the beginning of each regular issue of the PCT Gazette.

(54) Title: **DEVICE TO PRODUCE POLYURETHANE ARTICLES, RELATIVE METHOD AND POLYURETHANE ARTICLES THUS OBTAINED**



(57) Abstract: Device to produce polyurethane articles (37) covered by a film (19), including a mold (30) comprising a female part (13) and a male part (12) defining a molding cavity (18) inside which polyurethane material (24) is able to be injected. The device also comprises, in association with the perimeter edge of said female part (13), means able to exert a connection function in substantial cooperation with the zone of discontinuity between said female part (13) and said male part (12). The means comprise a movable annular ring-nut (22) including a first position (22a) to load a segment of said film (19) in order to insert said segment inside the mold, and a second position (22b) at least partly overlapping on the perimeter of said female part (13) in order to cooperate with said female part (13) during the molding of said polyurethane material (24).



**WO 02/20239 A1**

"DEVICE TO PRODUCE POLYURETHANE ARTICLES, RELATIVE METHOD  
AND POLYURETHANE ARTICLES THUS OBTAINED"

\* \* \* \* \*

#### FIELD OF THE INVENTION

5     The invention concerns a device to make polyurethane articles, covered with a decorative film, which consists of a molding apparatus equipped with means able to perform the function of a perimeter undercut of the article.

10    The invention also concerns a method to produce polyurethane articles, wherein the steps of thermoforming the covering film and injecting/molding the polyurethane material are carried out in a single piece of apparatus and substantially in a single step, allowing to eliminate the subsequent, laborious operations of filling, sanding and  
15    painting in order to obtain the finished product.

    The invention also allows to accelerate and automate both the steps of loading the film into the mold and also those of moving and discharging the covered polyurethane articles at the end of the forming/molding process.

20    The invention also concerns the polyurethane articles, covered with a decorative film, obtained with this method and this device. The invention is applied in the field of molding polyurethane articles, such as small articles of furniture, furniture wings, panels for automatic  
25    distributing machines or domestic appliances, containers, etc.

    The invention reduces to a minimum the number of working stages needed to complete the production process, reducing the relative times and spaces, and allows to obtain finished  
30    products of high quality and surface finish, with substantially any desired shape.

#### BACKGROUND OF THE INVENTION

    There are various methods, in the state of the art, to

produce polyurethane articles, which are finding more and more varied applications in many fields of use.

Such articles are obtained, at present, essentially by means of two production processes.

5 A first process provides to paint the surface of the article after it has been removed from the mold. This process requires complex operations on the article which has been removed from the mold, such as trimming, filling, sanding and painting. These operations are not only very  
10 laborious, but also they do not give satisfactory results which can be repeated with acceptable levels of standardisation. Moreover, they require considerable manpower and long production times.

Furthermore, these operations considerably limit the  
15 possibility of automating the production process.

A second process provides to apply a covering, protective film at least on the visible face of the polyurethane article.

In this case, the state of the art provides to thermoform  
20 a covering film in a first mold, to insert it into another mold, and then to inject the polyurethane inside this second mold. By means of this film, the polyurethane articles are ensured the necessary surface resistance and the desired aesthetic quality.

25 However, this technique, using pre-formed films, also has some disadvantages, including the surface quality of the product, which is never regular due to the plays in elasticity of the products which are heated at different times, and to the adaptation of the thermoformed film to the  
30 mold because of the injection of the polyurethane. A further problem is the absence of a constant quality.

Moreover, this technique requires large work surfaces, both to move the material and also to perform the various

working steps described above.

The present Applicant, in the patent application PCT/IB00/01084, proposed an innovative method to produce covered polyurethane articles, by means of thermoforming the covering film in a mold and injecting polyurethane material  
5 into the same mold, wherein most of the disadvantages listed above are eliminated.

The articles obtained with the method described above emerge from the mold substantially finished, and only  
10 require the perimeter trimming of the film.

Document WO 00/12282 describes a method to mold objects made of plastic material wherein a covering sheet is made to adhere, by means of jets of compressed air, against the wall of the upper part of the mold, and then the plastic material  
15 is injected from below in order to form the covered article.

Document WO 96/03267 describes a method to produce covered thermoplastic articles wherein a covering film is arranged inside the cavity of the mold, and then the thermoplastic material is injected to thrust the film against the wall of  
20 the mold. This method provides that the edges of the film can be released during the injection process to allow the film to move into contact with the wall of the mold while the injected material fills the cavity thereof.

Document DE-A-4033297 shows a method to produce covered  
25 thermoplastic articles substantially identical to the previous ones.

In these prior art documents a first problem concerns the correct finishing of the visible surface of the covered polyurethane article, which must not have any visible signs  
30 or marks deriving from the forming and injection process.

Another problem concerns the possibility of moving and discharging, in an easy and rapid fashion, the finished covered article at the end of the molding process.

A further problem concerns the possibility of achieving covered polyurethane articles with particular shapes and contours, for example with undercuts which may be different from each other on each occasion.

- 5     The Applicant has devised and embodied this invention to solve these and other problems, and to obtain further advantages as will be shown hereafter.

#### SUMMARY OF THE INVENTION

10    The invention is set forth and characterized in the respective main claims, while the dependent claims describe other characteristics of the main embodiment.

15    The purpose of the invention is to achieve a method and a device suitable to supply, in a single molding step and with a single apparatus, a substantially finished polyurethane article characterized by high surface quality, even when there are perimeter undercuts present.

20    Another purpose is to achieve a molding device equipped with means able to cooperate with the perimeter edge of the article when the mold is closed, such means allowing to form a perimeter undercut and preventing the creation of an imperfect and/or damaged edge in correspondence with the discontinuity created between the coupled surfaces of the male and female parts of said mold.

25    A further purpose is to achieve a production method wherein the steps can be largely automated and allow the automatic loading of the film in correspondence with the mold, and also the molding, removal and discharge of substantially finished articles, which require only a perimeter trimming of the covering film present.

30    Another purpose of the invention is to achieve a device wherein the shape, and in particular the perimeter edge, of the article can be changed quickly, without requiring complex operations to dis-assemble and re-assemble parts, or

the particular use of the labor force.

The molding device according to the invention comprises a molding apparatus consisting, in a substantially conventional fashion, of a female part, or matrix, suitable  
5 for the conformation of the visible face of the article, and a male part, or punch, suitable for the conformation of the non-visible face.

The male part is associated with press means able to move it from an open position to a closed position and  
10 incorporates the means to inject the polyurethane material when the mold is closed. The male and female parts of the mold have heating means which can be activated on command, for example, but not only, consisting of heated water circulating in the inner volume of the two elements, or of  
15 electric resistances, radiating elements, hot air, or other means.

In one embodiment of the invention, the heating means of the male and female part of the mold are autonomous and independent with respect to each other.

20 According to one characteristic of the invention, in association with the perimeter edge of the female part of the mold there are means able to perform a function of continuity and connection in correspondence with the zone of discontinuity between the male and female parts of the mold.

25 Said means are removable and replaceable and comprise, in a preferential embodiment, an annular ring-nut or frame which extends outside, and partly overlapping, the perimeter of the female part, so as to constitute substantially an auxiliary element, or counter-matrix, of the female part.

30 The annular ring-nut has at least one perimeter edge protruding forwards, in the direction of the molding cavity, which is shaped so as to cooperate with said discontinuity between the two parts of the mold, so that it is possible to

form a perimeter undercut.

In this way the annular ring-nut allows to form a perimeter edge of the article without imperfections or irregularities, so that the only operative step required  
5 after the article has been removed from the mold is the perimeter trimming of the possible excess film.

According to another characteristic of the invention, the annular ring-nut is associated with movement means which allow it to make at least the following displacements:

- 10 - to be positioned in a position outside the molding apparatus in order to lay, cut and clamp, on part of its perimeter, a segment of the covering film,
- to be translated towards the molding apparatus in order to insert the film into the mold,
- 15 - to be lowered into substantial co-operation with the perimeter edge of the female part of the mold,
- to be raised with respect to the female part, once the forming and molding step is completed, taking the molded article with it, and finally
- 20 - to be translated laterally with respect to the molding apparatus, in order to allow the article to be removed and discharged, exploiting the excess parts of the film protruding from the figure of the article.

In order to perform the operation of loading the film into  
25 the mold, the annular ring-nut includes first vacuum means able to retain the film at least temporarily against the upper surface of the ring-nut.

In one embodiment of the invention, the annular ring-nut also has second vacuum means able to locally create a vacuum  
30 in order to achieve the thermoforming of the covering film, said means including external suction holes and slits outside the figure of the molded article.

In a further embodiment, the annular ring-nut has heating



means, which can be selectively activated during the forming step of the film.

The heating means, according to a variant of the invention, are autonomous and independent with respect to  
5 the heating means of the components of the mold, so as to allow a selectively differentiated heating according to specific requirements.

In a preferential embodiment of the invention, the molding apparatus comprises pressure means, adjustable in pressure,  
10 suitable to cooperate with the surface of said annular ring-nut so as to define a sealing outer perimeter which retains the film mechanically during its thermoforming step.

According to a variant, said pressure means and said annular ring-nut have respective means, mating and  
15 cooperating, which prevent the formation of wrinkles and creases in the film during the thermoforming step and the subsequent injection of the polyurethane.

In another variant, in the case when the molding apparatus is of the type suitable for the simultaneous formation of  
20 two or three figures, there are cutting means provided suitable to cut the film in correspondence with a zone of separation between the two figures, in order to allow the two articles to be removed separately.

In a preferential embodiment, the annular ring-nut is of  
25 the interchangeable type, to allow to define perimeter edges, and the relative undercuts, of a different shape according to the specific application.

According to another variant, the molding apparatus comprises auxiliary heating means able to locally determine  
30 different temperatures with respect to the rest of the figure.

According to a further variant, the molding apparatus comprises means to deliver compressed air, able to be

selectively activated, to collaborate in the operation of forming the film and its adhesion to the inner surface of the female part of the mold.

There are many advantages to the invention, apart from the fact that it obtains a covered article, finished in every part, in a single step.

The complete thermoforming and definitive union of the film and the polyurethane are obtained using heat and pressure generated by the polymerization reaction of the polyurethane itself. This ensures that the quality is constant, that the whole visible surface of the article is perfect and that the results can be repeated; this cannot be obtained with known techniques.

The method eliminates all those steps subsequent to molding, such as filling, sanding and painting, thus bringing considerable advantages in terms of economy, safety (for example, the emission of solvents, waste disposal, fire risks, etc.) and ecology. Moreover, by eliminating these steps it is possible to automate a large part of the operations of the whole production process..

Using a removable and interchangeable ring-nut allows to achieve the desired perimeter undercuts in the article, and therefore allows, substantially in a single step, to produce articles with a complex and elaborate shape.

Moreover, thanks to the removable ring-nut, it is possible to automate the steps to load the film into the mold and to discharge the finished polyurethane article.

In order to obtain higher productivity, a further embodiment provides several molds in line, operating in sequence and having the same characteristics as those described above.

#### BRIEF DESCRIPTION OF THE DRAWINGS

These characteristics and advantages of the invention will

become clear from the following description of the preferential form of embodiment, given as a non-restrictive example, with reference to the attached drawings wherein:

Fig. 1 shows a section of a form of embodiment of the molding apparatus to produce covered polyurethane articles according to the invention;

Figs. 2a-2h show in sequence the cycle of loading, thermoforming, molding and discharge of the polyurethane article using the device according to the invention;

Fig. 3 shows an enlarged detail of the apparatus in Fig. 1;

Fig. 4 shows a variant of Fig. 3 in the case of a molding apparatus to make two separate figures.

#### DETAILED DESCRIPTION OF PREFERRED EMBODIMENTS

With reference to the attached Figures, the reference number 10 denotes in its entirety a molding device to produce polyurethane articles according to the invention.

The device 10 comprises a molding apparatus 30 consisting of a female part 13, or matrix, associated with a fixed support 14, and a male part 12, or punch, associated with a press element 11 driven to open/close by means of movement actuators which are not shown here.

Both the male part 12 and the female part 13 have heating means, of a conventional type and not shown here (for example internal conduits with heated water circulating).

The male part 12, in this case in a substantially central position, has an injection channel 17, associated with an injection head 117, through which the foamy polyurethane 24 is injected, when the mold is closed, into the molding cavity 18 defined between the male part 12 and the female part 13.

It is obvious that, within the field of the invention, the injection channel 17 could be located in a non-central position, or there could be two or more injection channels,

possibly usable in alternation.

In this case, the molding device 10 comprises means 20 able to feed a thermoformable covering film 19 which is first inserted into the mold 30 and then made to adhere  
5 through thermoforming, as will be explained better hereafter, to the inner wall of the female part 13.

The film 19 is between 0.2 and 1.4 mm thick, preferably between 0.4 and 0.8 mm.

In the embodiment shown here, and as can be seen in  
10 greater detail in Fig. 1, in cooperation with the perimeter of the female part 13 of the mold there is an annular ring-nut 22 of the removable type with a front perimeter edge 23 facing towards the molding cavity 18. The front edge 23 is  
15 suitable to perform a function of continuity, substantially in correspondence with the zone of separation which is formed, when the mold is closed, between the female part 13 and the male part 12 of the mold.

The front edge 23 preferentially has at least part of its perimeter shaped and rounded so as to connect the parts of  
20 the mold and so as to allow to form an edge of the article, with its relative perimeter undercut, in correspondence with said position of discontinuity.

In this way, the article can be discharged from the mold already substantially finished, and requires only the  
25 perimeter trimming of the possible excess film 19.

In the preferential embodiment, the annular ring-nut 22 has heating means 33, for example hot water circulating inside.

The heating means 33 are advantageously independent and  
30 autonomous with respect to the heating means associated with the matrix 13 and the punch 12, so as to be able to determine a differentiated heating in the various zones of the film 19 and/or of the injected polyurethane.

The annular ring-nut 22 according to the invention is able to be moved so that first the film 19 is inserted into the mold 30 and then the finished polyurethane article is discharged from the said mold 30.

5 The cycle to move the ring-nut 22 to perform the molding of a polyurethane article is shown in Figs. 2a-2h.

In Fig. 2a, the ring-nut 22 is in a position 22a outside the mold 30 and near the means 20 to feed the film 19.

Gripper means 31, able to translate on a substantially  
10 horizontal plane, are arranged to grip the end of the film 19, unroll a segment of a defined length and lay said segment above the ring-nut 22. When the film 19 has been arranged above the ring-nut 22, cutting means 32 are activated to cut the segment from the reel 20.

15 In this step, first vacuum means 26 are activated, arranged inside and on the perimeter of the ring-nut 22, which are able to be selectively activated to retain the film in co-operation, in this case, with the two short sides of the ring-nut 22.

20 The ring-nut 22 is then translated on a substantially horizontal plane (Fig. 2b) to be taken to a position 22b substantially inside the mold 30, in an intermediate position between the matrix 13 and the punch 12. Then, the ring-nut 22 is lowered substantially to rest on and couple  
25 with the perimeter of the matrix 13, with the film 19 held taut above the molding cavity 18 (Fig. 2c).

At this point, the punch 12 is lowered into contact with the film to heat it, and pressure means 21 are activated to mechanically clamp the film 19 in position on the upper edge  
30 of the ring-nut 22 (Fig. 2d).

In the embodiment shown here, the action of the pressure means 21 is advantageously adjustable in intensity; in cooperation with relative segments of the upper surface of

the annular ring-nut 22, the pressure means 21 define the housing for perimeter vacuum sealing means, such as O-rings 27.

5 In the case shown here, the pressure means 21 have a tooth 25 suitable to cooperate with a mating cavity 28 made on the perimeter of the annular ring-nut 22, in order to prevent the formation of folds and wrinkles in the film 19 during thermoforming.

10 The first vacuum means 26 are then de-activated, while the heating means 33 inside the ring-nut 22 are activated and also second vacuum means 126, able to determine the thermoforming of the film 19 and its adhesion to the inner surface of the matrix 13.

15 During the thermoforming step, according to the variant shown in Fig. 1, means to deliver compressed air 34 associated with the punch 12 are activated to cooperate with said heating means 33 and said second vacuum means 126 in order to complete the thermoforming operation of the film 19.

20 It should be noted that both the first vacuum means 26 and especially the second vacuum means 126 which are activated during the thermoforming of the film 19 have their relative suction holes arranged outside the figure of the polyurethane article; as a result, when they are activated  
25 they do not cause signs, prints or other marks of any type on the visible face of the finished product after molding, which ensures a high surface quality of the visible face.

In this step, it is also possible to activate auxiliary heating means 38 to determine differentiated and localized  
30 heating in specific zones of the film 19.

When the thermoforming is complete, the punch 12 is closed on the matrix 13 and the injection of the foam polyurethane 24 is begun through the injection head 117 and the injection

channel 17 (Fig. 2e).

The heat and pressure generated during polymerization of the polyurethane 24 cause the thermoforming of the film 19 to be completed, and the film 19 is definitively and stably  
5 attached to the outer surface of the article.

When molding is complete, the mold is opened (Fig. 2f) and the annular ring-nut 22 is first raised and then translated laterally, to allow the article 37 to be removed. The article 37 thus achieved remains resting on the annular  
10 ring-nut 22 due to the presence of the perimeter edge of the excess film 19.

Finally, the ring-nut 22 is returned to its initial position 22a (Fig. 2g) to allow the expulsion means 35 to be activated, which allow to discharge the polyurethane article  
15 37 which falls into an underlying collection tray 36.

From the tray 36, the finished article is sent to a station for the perimeter trimming of the excess film 19, in order to complete the process and to obtain the finished piece.

20 In the event that the mold is used to simultaneously make two or more adjacent figures (Fig. 4), cutting means 29 are provided to separate the film 19 in correspondence with an intermediate position of said two figures, allowing to remove and discharge individually the two articles thus  
25 obtained.

It comes within the field of the invention to provide systems able to apply two films 19, one for each side of the article.

It also comes within the field of the invention to provide  
30 that a single press comprises not only two or more figures, but also two or more molds driven simultaneously.

Additions and/or modifications can be made to the method and device as described heretofore without departing from

the spirit and scope thereof.

It is also obvious that, although the invention has been described with reference to specific examples, a person skilled in the art shall certainly be able to achieve many  
5 other equivalent solutions, all of which shall come within the field and scope of the invention.



## CLAIMS

- 1 - Device to produce polyurethane articles (37) covered by a film (19), including a mold (30) comprising a female part (13) and a male part (12) able to define, when the mold is  
5 in the closed position, a molding cavity (18) inside which polyurethane material (24) is able to be injected, said device also comprising, in association with the perimeter edge of said female part (13), means able to perform a connection function in substantial cooperation with the zone  
10 of discontinuity between said female part (13) and said male part (12), characterized in that said means comprise a movable annular ring-nut (22) including a first position (22a) to load a segment of said film (19) in order to insert said segment inside the mold, and a second position (22b),  
15 at least partly overlapping on the perimeter of said female part (13) in order to cooperate with said female part (13) during the molding of said polyurethane material (24).
- 2 - Device as in claim 1, characterized in that said first position (22a) is outside the mold (30).
- 20 3 - Device as in claim 1 or 2, characterized in that said second position (22b) is inside the mold (30).
- 4 - Device as in any claim hereinbefore, characterized in that said annular ring-nut (22) has at least a perimeter edge (23) protruding forwards towards said molding cavity  
25 (18) and able to allow the formation of a perimeter undercut in correspondence with the perimeter edge of the polyurethane article (37).
- 5 - Device as in any claim hereinbefore, characterized in that, at least on the perimeter, said annular ring-nut (22)  
30 has first vacuum means (26) able to be selectively activated and able to exert an action of at least temporary retention of said segment of film (19) during the insertion of said segment into said mold (30).

6 - Device as in any claim hereinbefore, characterized in that, at least on the perimeter, said annular ring-nut (22) has second vacuum means (126) able to be selectively activated and able to locally create a vacuum to cooperate  
5 in the thermoforming of said segment of film (19) inside said mold (18).

7 - Device as in claims 5 and 6, characterized in that said first (26) and said second (126) vacuum means include relative suction holes arranged in a position outside the  
10 figure of the polyurethane article (37) to be made.

8 - Device as in any claim hereinbefore, characterized in that, at least on the perimeter, said annular ring-nut (22) has heating means (33) able to be selectively activated and able to heat said segment of film (19) at least locally  
15 during the thermoforming step inside said mold (30).

9 - Device as in any claim hereinbefore, characterized in that it comprises pressure means (21) arranged at least on the perimeter in cooperation with at least part of the upper surface of said annular ring-nut (22) and able to  
20 mechanically retain said segment of film (19) at least during the thermoforming step.

10 - Device as in claim 9, characterized in that, in cooperation with a relative part of the upper surface of said annular ring-nut (22), said pressure means (21) define  
25 at least a housing seating for perimeter sealing means (27).

11 - Device as in claim 10, characterized in that said perimeter sealing means comprise at least an O-ring (27) housed partly in said annular ring-nut (22) and partly in said pressure means (21).

30 12 - Device as in any claim from 9 to 11 inclusive, characterized in that, in cooperation with a relative part of the upper surface of said annular ring-nut (22), said pressure means (21) define tensioning means (25, 28) to

prevent wrinkles in said film (19) during the forming step.

13 - Device as in any claim hereinbefore, characterized in that it comprises means to deliver compressed air (34), able to be selectively activated and able to cooperate with said  
5 segment of film (19) at least during the thermoforming step.

14 - Device as in any claim hereinbefore, characterized in that it comprises auxiliary heating means (38) able to heat, locally and in a desired fashion, pre-determined zones of said segment of film (19).

15 15 - Device as in any claim hereinbefore, characterized in that, at the end of the operation to mold and form the polyurethane article (37) and to open the mold (30), said annular ring-nut (22) is able to return to a position (22a) outside the mold (30), taking with it said polyurethane  
15 article (37), to allow the extraction and discharge thereof.

16 - Device as in claim 15, characterized in that it comprises expulsion means (35) able to cooperate with said annular ring-nut (22) in its position (22a) outside the mold (30) to allow said polyurethane article (37) to be  
20 discharged and to fall onto collection means (36).

17 - Device as in claim 1, characterized in that it comprises extractor means (31) able to cooperate with said annular ring-nut (22) in its position (22a) outside the mold (30) to lay said segment of film (19) in cooperation with at  
25 least part of its perimeter.

18 - Device as in any claim hereinbefore, characterized in that it comprises a mold used to form two figures simultaneously, cutting means (29) being provided in correspondence with an intermediate position between said  
30 two figures to cut said film (19).

19 - Device as in claim 8, wherein said male part (12) and/or said female part (13) include heating means able to be selectively activated, characterized in that said heating

means (33) of said annular ring-nut (22) are fed in independent and autonomous fashion with respect to said heating means of said male (12) and/or female (13) part.

20 - Method to produce, inside a mold (30), polyurethane  
5 articles (37) covered with a film (19), wherein polyurethane (24) is injected inside a molding cavity (18) defined by the coupling of a female part (13) and a male part (12), at least one of the two parts, male (12) and female (13), being heated, wherein there are present, in association with the  
10 perimeter edge of said female part (13), means (22) able to perform a connection function in substantial cooperation with the zone of discontinuity between said female part (13) and said male part (12), said means (22) allowing to form a perimeter undercut in correspondence with an edge of said  
15 article (37), characterized in that, in order to insert a segment of said film (19) into the mold (30), the method provides that said means (22) are taken first to a position (22a) outside said mold (30) so that said segment of film (19) can be loaded and clamped onto at least part of the  
20 perimeter of said means (22), then that said means (22) are translated to a position (22b) inside the mold (30) and positioned at least partly overlapping the perimeter of said female part (13).

21 - Method as in claim 20, characterized in that, during  
25 the displacement of said means (22) from the position (22a) outside the mold (30) to the position (22b) inside the mold, first vacuum means (26) present at least on the perimeter of said means (22) are activated to maintain said segment of film (19) clamped on the upper surface of said means (22).

30 22 - Method as in claim 20, characterized in that, after said means (22) have been positioned partly overlapping the perimeter of said female part (13), the method provides a step of thermoforming of said segment of film (19) in order

to make it adhere to the walls of said molding cavity (18).

23 - Method as in claim 22, characterized in that, during the thermoforming step, second vacuum means (126) present at least on the perimeter of said means (22) and arranged  
5 outside the figure of the polyurethane article (37) to be made, are activated to attract said segment of film (19) against the walls of said molding cavity (18).

24 - Method as in claim 22 or 23, characterized in that, during the thermoforming step, heating means (33), present  
10 at least on the perimeter of said means (22), are activated to heat said segment of film (19).

25 - Method as in any claim from 22 to 24 inclusive, characterized in that, during the thermoforming step, means (34) to deliver compressed air are activated to cooperate in  
15 the adhesion of said segment of film (19) against the walls of said molding cavity (18).

26 - Method as in any claim from 22 to 25 inclusive, characterized in that, during the thermoforming step, auxiliary heating means (38) are activated to locally heat  
20 specific zones of said segment of film (19).

27 - Method as in any claim from 22 to 26 inclusive, characterized in that, after the thermoforming of said segment of film (19), the method comprises the following steps:

25 - polyurethane material (24) is injected by means of an injection head (117) with an injection channel (17);  
- the polyurethane material is polymerized and molded, the thermoforming of said film (19) is consequently completed and said film (19) is stably constrained to the surface of  
30 the polyurethane material (24).

28 - Method as in claim 27, characterized in that, when molding is complete, the method provides that said means (22) are removed from the mold (30) to proceed with the

discharge of said polyurethane article (37), which remains with the segments of film (19) which are excess to the figure resting on the perimeter of said means (22).

29 - Method as in claim 28, characterized in that it  
5 provides that said means (22) are taken to said position (22a) outside the mold (30) to cooperate with expulsion means (35) to expel said polyurethane article (37).

30 - Method as in claim 20, characterized in that in said  
10 position (22a) outside the mold (30) extractor means (31) cooperate with means (20) to feed said film (19) in order to position a segment of said film (19) in co-operation with at least part of the perimeter of said means (22).

31 - Polyurethane articles obtained through injection and molding, in a single step, inside a mold comprising at least  
15 a male part (12) and a female part (13), characterized in that at the end of the molding process they have their perimeter edge equipped with a perimeter undercut the formation of which is defined by auxiliary means (22, 23) able to perform a function of connection in substantial  
20 cooperation with the zone of discontinuity between the female part (13) and the male part (12) of the mold.

32 - Polyurethane articles as in claim 31, characterized in that they have at least a film (19), thermoformed in the mold before the polyurethane (24) is injected, constrained  
25 at least partly onto a body made of expanded polyurethane.

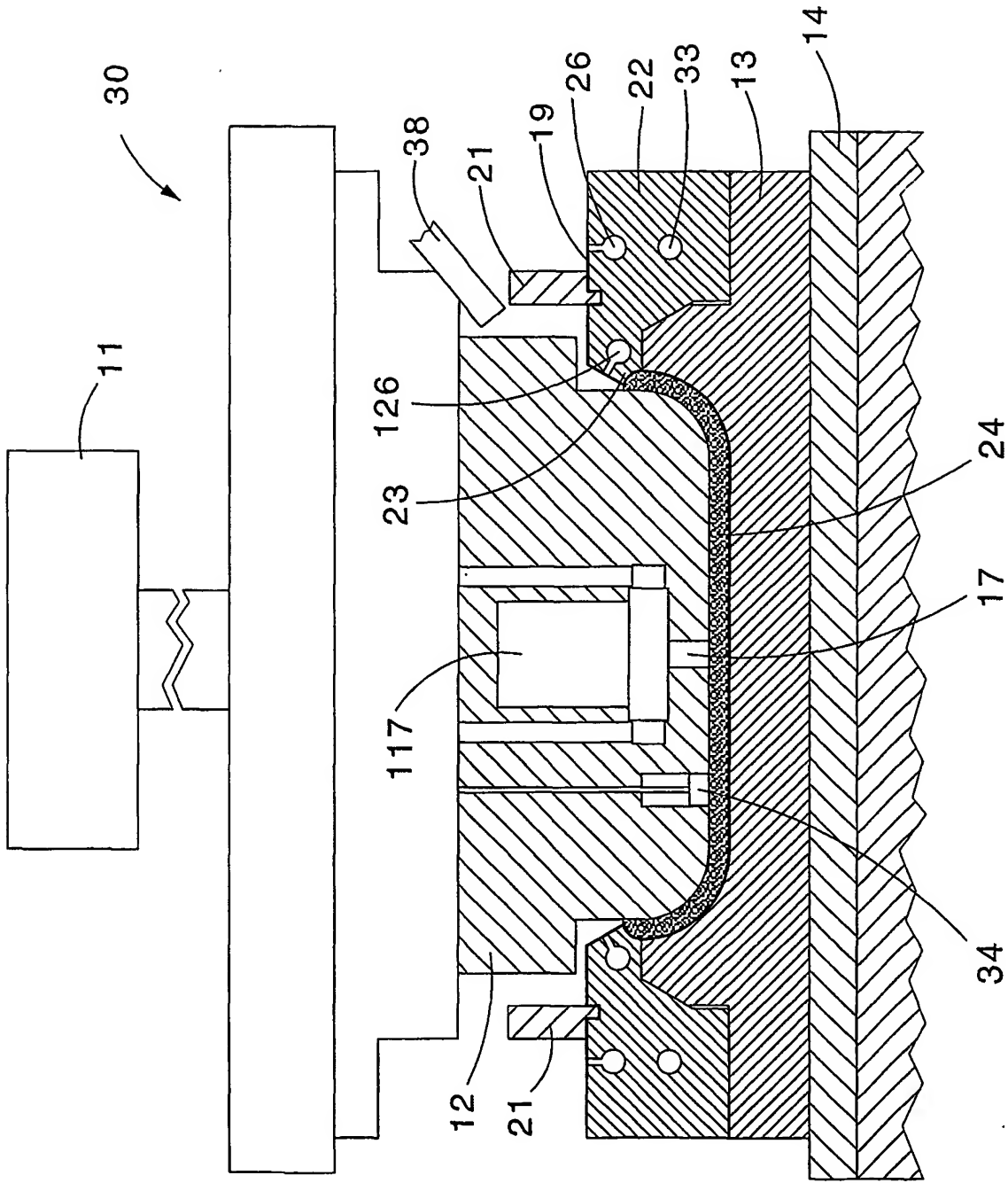
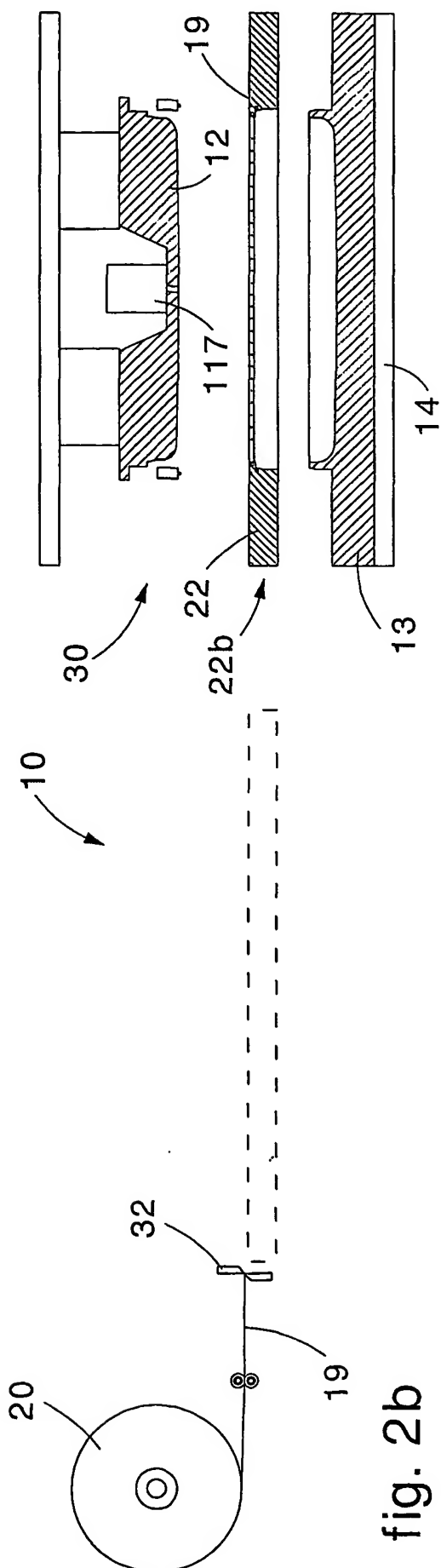
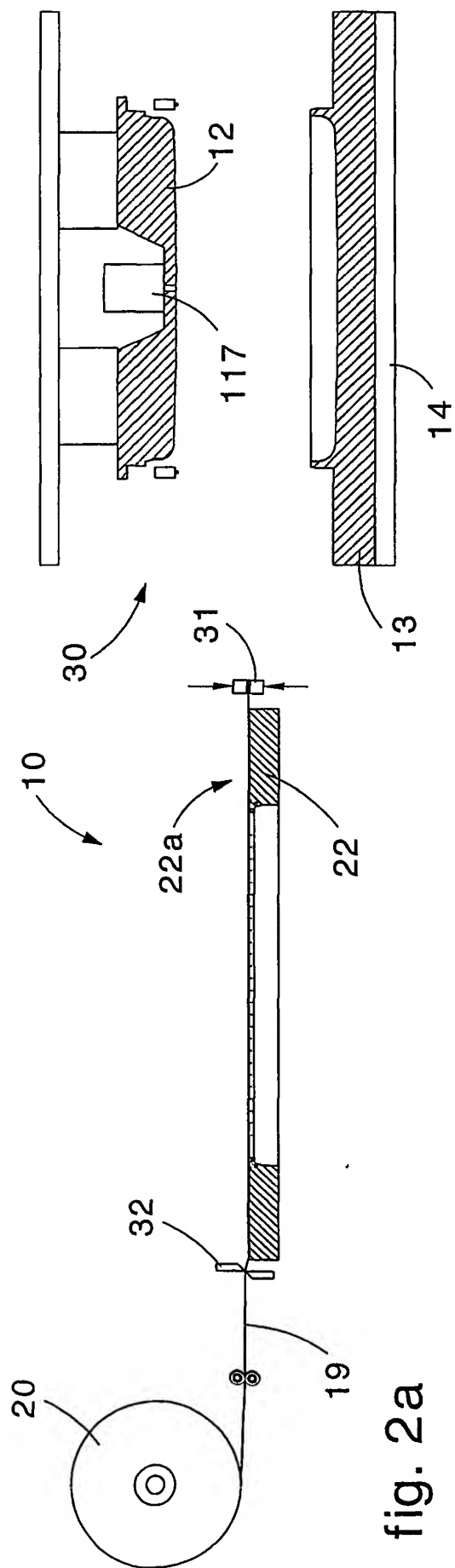


fig. 1





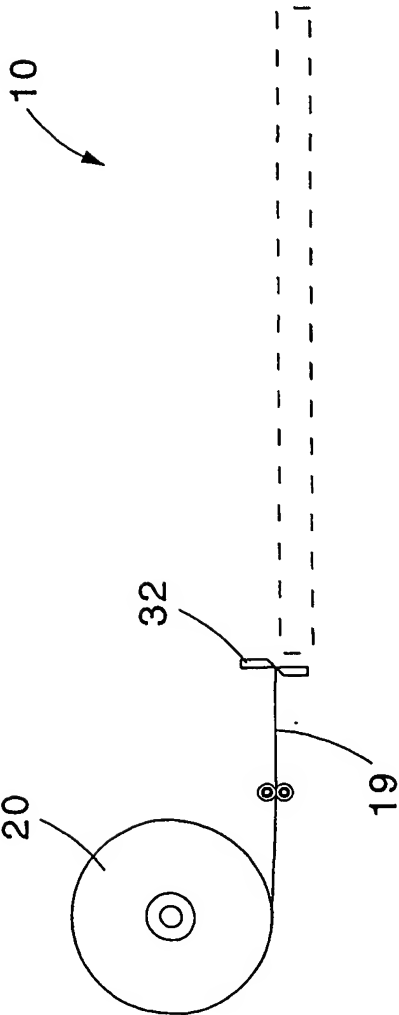


fig. 2c

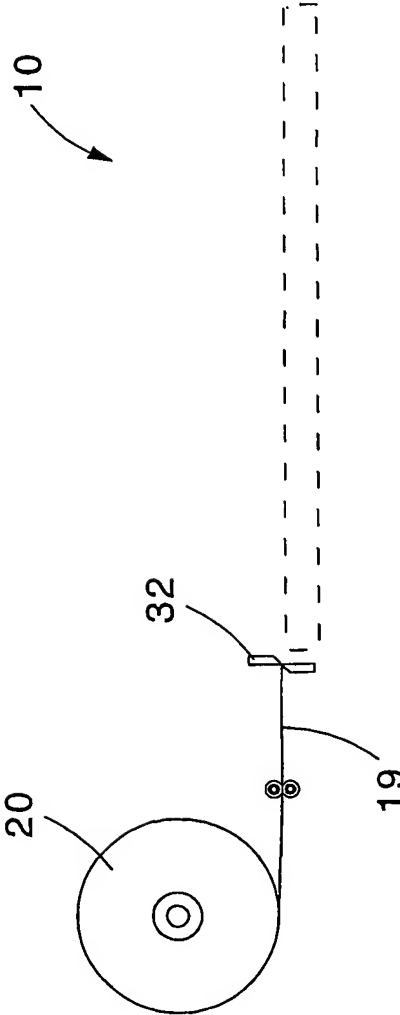
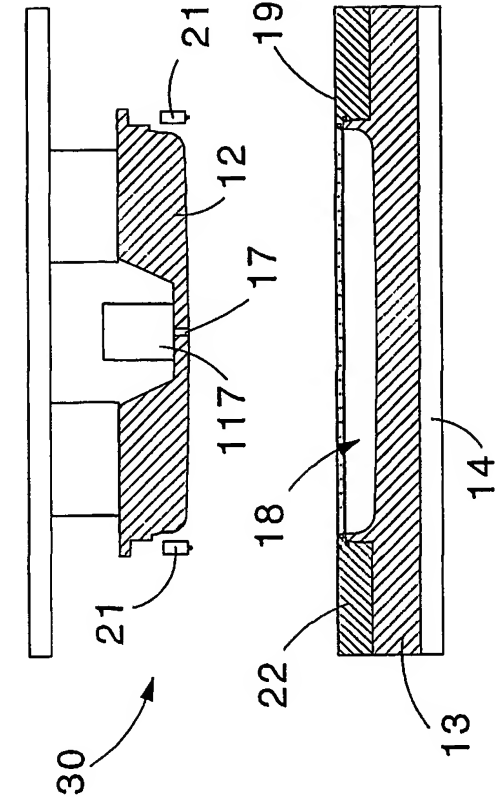
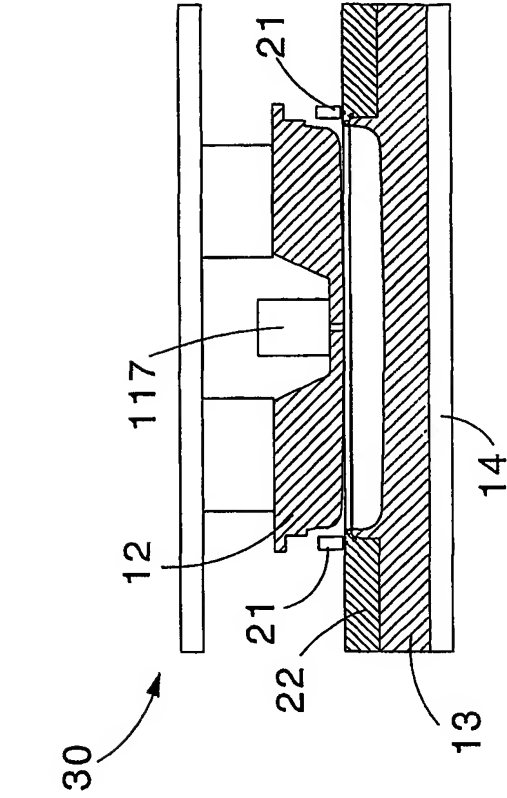


fig. 2d



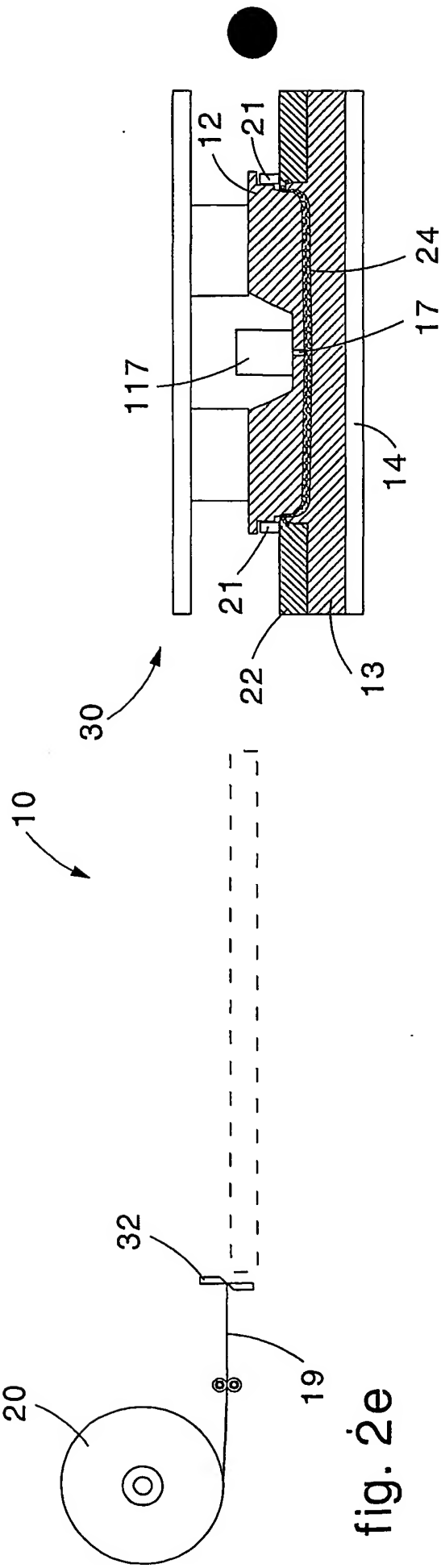


fig. 2e

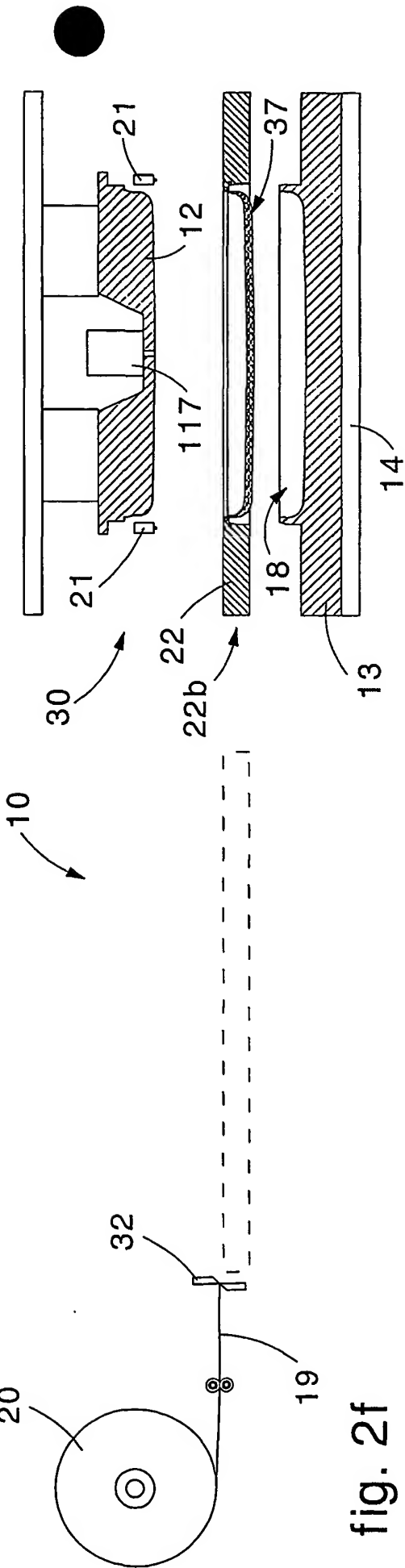
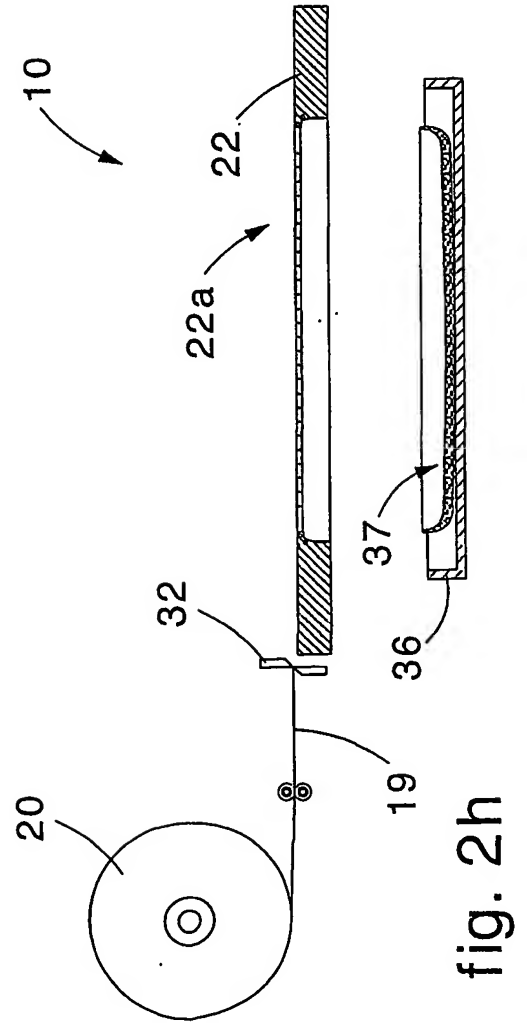
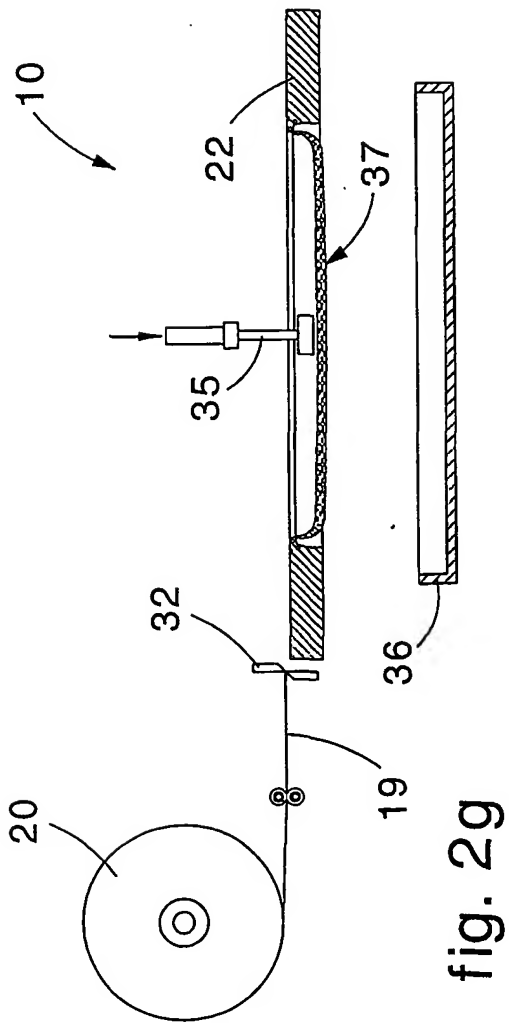


fig. 2f

5/7



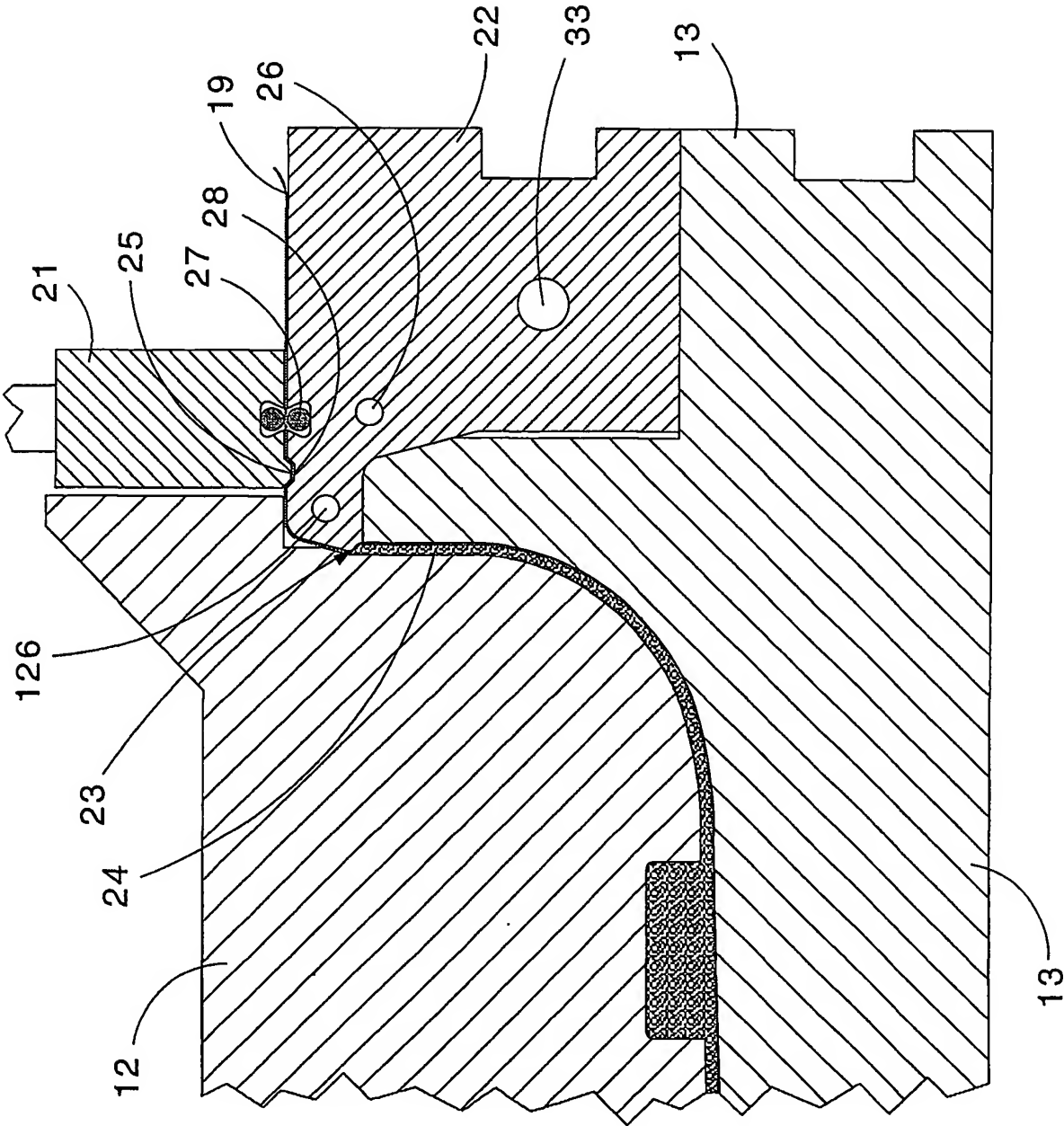


fig. 3

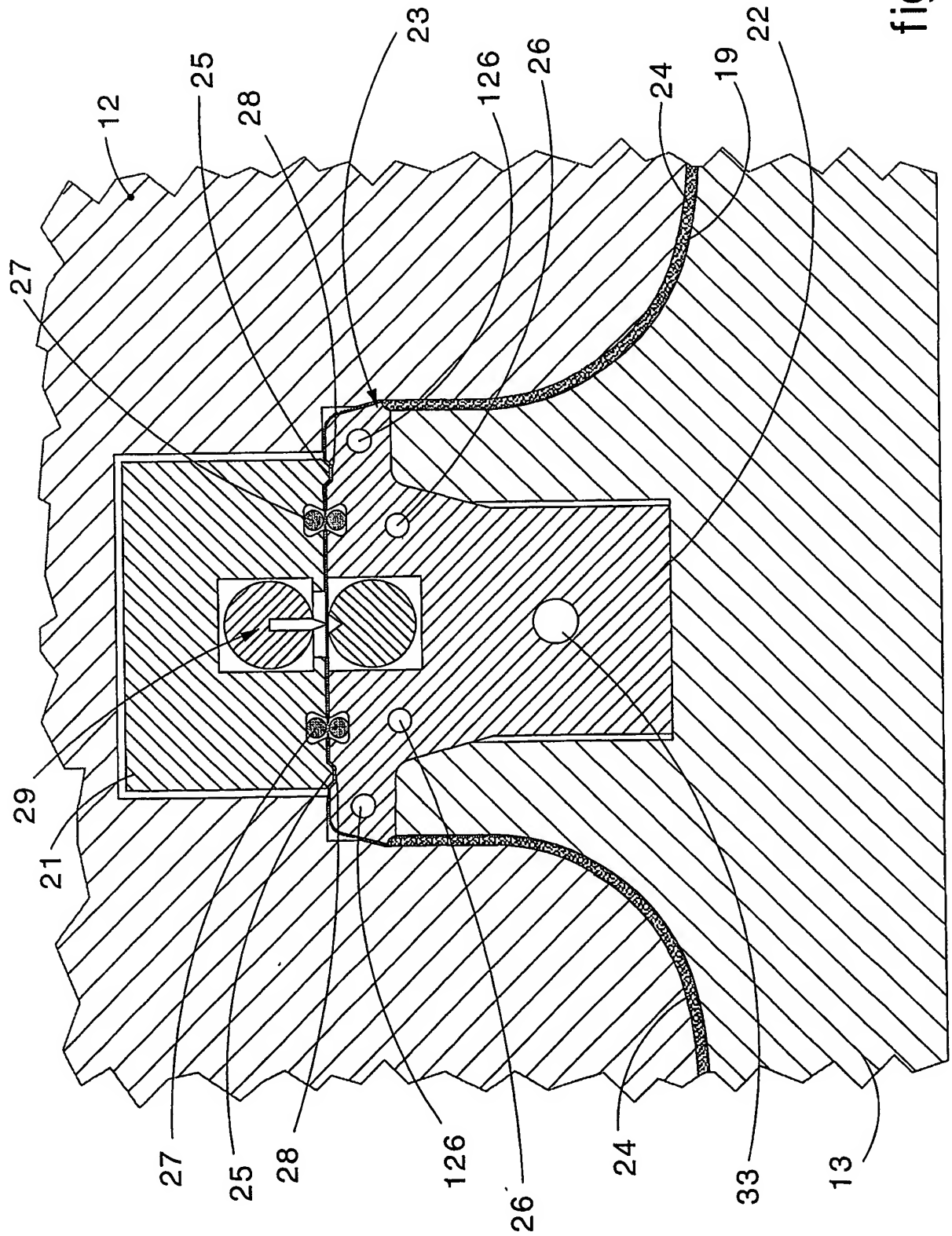


fig. 4

A. CLASSIFICATION OF SUBJECT MATTER  
IPC 7 B29C45/14 B29C44/14

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC 7 B29C

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

PAJ, EPO-Internal

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	WO 96 03267 A (DECOMA INT. INC) 8 February 1996 (1996-02-08) cited in the application	1,4,7,20
X	the whole document	31
A	WO 95 27604 A (DUOTEC PRODUCTS ASSOCIATES) 19 October 1995 (1995-10-19)	1,4,20
X	the whole document	31
A	WO 00 12282 A (CORELL RESIN TECHNOLOGY BV) 9 March 2000 (2000-03-09) cited in the application	1,13,20, 22,25
	the whole document	
	---	
	---/---	

☒ Further documents are listed in the continuation of box C.

☒ Patent family members are listed in annex.

\* Special categories of cited documents:

\*A\* document defining the general state of the art which is not considered to be of particular relevance

\*E\* earlier document but published on or after the international filing date

\*L\* document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

\*O\* document referring to an oral disclosure, use, exhibition or other means

\*P\* document published prior to the international filing date but later than the priority date claimed

\*T\* later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

\*X\* document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

\*Y\* document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.

\*G\* document member of the same patent family

Date of the actual completion of the international search

3 December 2001

Date of mailing of the international search report

10/12/2001

Name and mailing address of the ISA

European Patent Office, P.B. 5818 Patentlaan 2  
NL - 2280 HV Rijswijk  
Tel (+31-70) 340-2040, Tx. 31 651 epo nl,  
Fax: (+31-70) 340-3016

Authorized officer

Bollen, J

C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT		
Category *	Citation of documents      Indication, where appropriate, of the relevant passages	Relevant to claim No.
A	PATENT ABSTRACTS OF JAPAN vol. 9, no. 245 (M-418), 2 October 1985 (1985-10-02) & JP 60 097816 A (TOYOTA JIDOSHA KK), 31 May 1985 (1985-05-31) abstract -----	1,4,20
A	DE 40 33 297 A (ENGEL MASCHINENBAU GMBH) 2 May 1991 (1991-05-02) cited in the application the whole document -----	1,4,20
A	EP 0 584 042 A (VALYI EMERY I) 23 February 1994 (1994-02-23) the whole document -----	1,20
A	DE 198 54 663 A (HERBST RICHARD) 8 June 2000 (2000-06-08) the whole document -----	1,20
A	WO 91 17035 A (ONTARIO DIE CO. OF AMERICA) 14 November 1991 (1991-11-14) page 12, line 1 - line 4; figures 2,3 -----	9,10

Patent document cited in search report		Publication date	Patent family member		Publication date
WO 9603267	A	08-02-1996	US	6090336 A	18-07-2000
			CA	2195458 A1	08-02-1996
			WO	9603267 A1	08-02-1996
			DE	69511874 D1	07-10-1999
			DE	69511874 T2	17-02-2000
			EP	0771262 A1	07-05-1997
WO 9527604	A	19-10-1995	CA	2187013 A1	19-10-1995
			WO	9527604 A1	19-10-1995
WO 0012282	A	09-03-2000	AU	5535499 A	21-03-2000
			NL	1012957 C2	02-03-2000
			WO	0012282 A1	09-03-2000
JP 60097816	A	31-05-1985	NONE		
DE 4033297	A	02-05-1991	AT	398404 B	27-12-1994
			AT	250489 A	15-04-1994
			DE	4033297 A1	02-05-1991
			IT	1240991 B	27-12-1993
EP 0584042	A	23-02-1994	AT	172143 T	15-10-1998
			CA	2101300 A1	05-02-1994
			DE	69321536 D1	19-11-1998
			DE	69321536 T2	17-06-1999
			EP	0584042 A1	23-02-1994
			US	5401457 A	28-03-1995
			US	6159402 A	12-12-2000
DE 19854663	A	08-06-2000	DE	19854663 A1	08-06-2000
WO 9117035	A	14-11-1991	WO	9117035 A1	14-11-1991
			US	5182065 A	26-01-1993